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| 10/653,190 | 09/03/2003 | Ofer Dagan | 116956 | 1741 |

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| EXAMINER | |
|---|---|
| SUNG, CHRISTINE | |
| **ART UNIT** | **PAPER NUMBER** |
| 2884 | |

DATE MAILED: 06/07/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

| Office Action Summary | Application No. | Applicant(s) | |
|---|---|---|---|
| | 10/653,190 | DAGAN ET AL. | |
| | Examiner | Art Unit | |
| | Christine Sung | 2884 | |

*-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --*

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

1)☒ Responsive to communication(s) filed on *13 March 2006*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

4)☒ Claim(s) *1-31* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-16,20-29 and 32-34* is/are rejected.

7)☒ Claim(s) *17-19,30 and 31* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

**Application Papers**

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *03 September 2003* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☒ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

***Response to Amendment***

1. The amendment filed on March 13, 2006 has been accepted and entered.

***Priority***

2. Acknowledgment is made of applicant's claim for foreign priority based on an application filed in Israel on September 5, 2002. It is noted, however, that applicant has not filed a certified copy of the 151634 application as required by 35 U.S.C. 119(b).

***Claim Rejections - 35 USC § 102***

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

4. Claims 1, 3, 4-5, 8, 20-22, 24-26, 29 and 32-34 are rejected under 35 U.S.C. 102(e) as being anticipated by Iwanczyk (US Pre Grant Publication 2003/0021382 A1).

Regarding claim 1, Iwanczyk discloses a method for detecting single photons of high-energy radiation (paragraph [0034]) using a detector (Figure 13, element $HgI_2$ Array) comprising an array of pixels, each pixel including a charge receptive substrate (Figure 14, element 406), said method including the operations of:

capturing high-energy photons (paragraph [0034]) with the pixel array, the photons generating high-energy ionizing particles within a polycrystalline film (element 404 and claim 22) deposited on the pixels, and whereby the ionizing particles generate a charge;

collecting the generated charges in each pixel by the charge receptive substrate thereof (element 404);

reading out the collected charges using low noise electronics (Figure 13, element 360) ;

and analyzing the read out charges, thereby to detect single photons (figure 11, elements 308 and 310).

Regarding claim 3, Iwanczyk discloses that the polycrystalline film has a mobility-lifetime product exceeding $10^{-5}$ $cm^2$/Vsec (paragraph [0078]).

Regarding claim 4, Iwanczyk discloses that the detector detects on average an electronic charge for each 15 eV or less of incident high-energy radiation detected (paragraph [0069]).

Regarding claim 5, Iwanczyk discloses that the analyzing operation includes the operation of comparing the read out collected charges from the reading out operation to a previously determined relationship (paragraph [0079]),

the relationship being generated from a calibration based on a statistical analysis of charges/photon over an expected range of photon energies (paragraph [0079]), the relationship being stored in a processor prior to beginning said capturing operation (Paragraph [0079], RAD-CHECK®).

Regarding claim 8, Iwanczyk includes the operation of imaging the pixels in which single photons have been detected (paragraph [0013]).

Regarding claim 20, Iwanczyk discloses that the charge receptive substrate is chosen is a thin film transistor (TFT) (Figure 14, element 406 and paragraph [0030])) or a complementary metal oxide semiconductor (CMOS) (paragraph [0030]).

Regarding claim 21, Iwanczyk discloses that the polycrystalline film has a thickness sufficient to absorb 50% of the incident high-energy radiation (Figure 6).

Regarding claim 22, Iwanczyk discloses that the polycrystalline film is mercuric iodide (paragraph [0030]).

Regarding claim 24, Iwanczyk discloses a method for detecting single photons of high-energy radiation according to claim 1, and further discloses that the detection is effected by:

a detector comprising an array of pixels (Figure 1, element 354), each pixel having:

a polycrystalline photoconductive film (Figure 1, element 404) having a mobility-lifetime product exceeding $10^{-5}$ $cm^2/Vsec$ (paragraph [0078]);

a conductive contact pad (figure 12, element 328) to contact said polycrystalline film;

a conductive contact deposited on top of said film (Figure 12, element 322), said contact to provide a bias voltage (claim 23);

a charge receptive substrate (Figure 14, element 406) which collects charges generated in said films by the high-energy photons, said substrate having said film deposited thereon (see figure 14);

low-noise electronics in communication with said substrate and reading out the charges collected by said substrate (figure 13, element 360);

and a processor for processing a digital signal produced in and transferred from said electronics (Figure 11, element 308), said processor using a previously determined relationship between charges produced per photon to detect single photons (paragraph [0079]), said relationship stored in said processor.

Regarding claim 25, Iwanczyk discloses that the polycrystalline film is mercuric iodide (paragraph [0030]).

Regarding claim 26, Iwanczyk discloses a system for detecting single photons of high energy radiation (paragraph [0034]), said system including:

a detector (figure 13, element 352), said detector including a pixel array (see HgI2 array), each pixel of said array having a polycrystalline photoconductive film (figure 14, element 404) deposited on a charge receptive substrate (Figure 14, element 406),

said detector operative to capture high-energy photons (paragraph [0034]);

low noise electronics (Figure 13, element 360) for reading out charges generated by the high energy photons when the photons interact with said film (claim 22),

the generated charges of each of said pixels being collected by said charge receptive substrate of said pixel and read out by said electronics (Figure 14, elements 406);

and a data processor (Figure 11, element 308) in communication with said low noise electronics, said processor including a stored previously determined relationship between charge produced per incident photon (paragraph [0079]), said relationship used for comparing the collected charges with said relationship, thereby to detect single photons.

Regarding claim 29, Iwanczyk discloses a system, wherein said polycrystalline film has a mobility-lifetime product exceeding $10^{-5}$ $cm^2/Vsec$ (paragraph [0078]).

Regarding claim 32, Iwanczyk discloses a system, wherein said charge receptive substrate (Figure 14, element 406) includes an electronic circuit fabricated from thin film electronic devices (paragraph [0030])) deposited on an inert substance (Figure 12, element 330).

Regarding claim 33, Iwanczyk discloses that the polycrystalline film is mercuric iodide (paragraph [0030]).

Regarding claim 34, Iwanczyk discloses that the charge receptive substrate is chosen is a thin film transistor (TFT) (Figure 14, element 406 and paragraph [0030])) or a complementary metal oxide semiconductor (CMOS) (paragraph [0030]).

***Claim Rejections - 35 USC § 103***

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

6. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

7. Claim 2 is rejected under 35 U.S.C. 103(a) as being unpatentable over Iwanczyk (US Pre Grant Publication 2003/0021382 A1) in view of Cox (US Patent 5,464,984 A).

Regarding claim 2, Iwanczyk discloses method according to claim 1, and further discloses that the pixel array is 1 $cm^2$ (Paragraph [0074]), but does not specify that the pixels are less that 1$mm^2$. However, such a pixel size is known in the art, as demonstrated by Cox (column

9, lines 50-57). One of ordinary skill in the art would be motivated to use the pixel dimensions as disclosed by Cox with the invention as disclosed by Iwanczyk in order to increase the spatial resolution.

8. Claims 6-7, 9-10, 23 and 27-28 are rejected under 35 U.S.C. 103(a) as being unpatentable over Iwanczyk (US Pre Grant Publication 2003/0021382 A1).

Regarding claims 6-7 and 10, Iwanczyk discloses a method according to claim 5, and further discloses that the detected data is compared to known calibration data (paragraphs [0079-0081]), but does not explicitly state that the relationship is stored as a look-up table or a function. However, it would be obvious to one having ordinary skill in the art to use a table or function in order to tabulate the calibration data in order to increase the speed at which the calibration is done by organizing the data in a form that is conducive for easy retrieval.

Regarding claim 9, Iwanczyk discloses a method according to claim 1, and further discloses that the analyzing operation further includes the operations of: comparing the read out collected charges from said reading out operation to a previously determined relationship (paragraph [0079]),

the relationship generated from a calibration based on a statistical analysis of charge/photon over an expected range of photon energies (paragraph [0079]),

the relationship being stored in a processor prior to beginning said capturing operation (paragraph [0079]);

and after said analyzing operation: preparing an image based on the pixels identified in said identifying operation (paragraph [0013]).

Iwanczyk does not specify identifying the pixels interacting with fewer than a predetermined number of photons during a readout based on the comparison of said comparing operation; recording the number of photons at each identified pixel in a frame. However, Iwanczyk discloses that the energy level which dictates the number of photons and also discloses making an image (paragraph [0013]). It would be obvious to one having ordinary skill in the art that by taking an image within a predetermined energy range, it is effectively identifying all pixels that have received radiation, and that the image is a recording of the all of the photons detected within a frame.

Regarding claim 23, Iwanczyk disclose a method according to claim 1, and further discloses that the high energy radiation is high flux radiation (radiation/area/time). It would be obvious to one having ordinary skill in the art to readout the charges rapidly so that there isn't a pileup of signals which reduces the accuracy of the detector.

Regarding claims 27-28, Iwanczyk discloses a system according to claim 26, and further discloses that the detected data is compared to known calibration data (paragraphs [0079-0081]), but does not explicitly state that the relationship is stored as a look-up table or a function. However, it would be obvious to one having ordinary skill in the art to use a table or function in order to tabulate the calibration data in order to increase the speed at which the calibration is done by organizing the data in a form that is conducive for easy retrieval.

9. Claims 11-15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Iwanczyk (US Pre Grant Publication 2003/0021382 A1) in view of Zur (US Patent 6,243,441 B1).

Regarding claims 11-15, Iwanczyk discloses a method according to claim 1, but does not specify that the analyzing operation includes detecting single photon events in a series of frames

taken over a period of time. However, Zur, discloses an x-ray radiation readout method wherein a series of images are taken at a rate of 30 frames per minute (column 13, lines 25-30). One of ordinary skill in the art would be motivated to use the frame speed as disclosed by Zur with the invention as disclosed by Iwanczyk in order to increase accuracy during dynamic imaging.

10. Claim 16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Iwanczyk (US Pre Grant Publication 2003/0021382 A1) in view of Pieters (US Patent 3,787,620 A).

Regarding claim 16, Iwanczyk discloses that the analyzing operation further includes a discriminating operation that discriminates between photon energies differing by at least 5 keV (paragraph [0069]), but does not explicitly stat that said discriminating operation is effected using a readout rate which detects no more than one photon per frame. However, Pieters discloses a readout rate which reads out one photon per frame (Column 2, lines 25-29). One of ordinary skill in the art would be motivated to use the readout rate as disclosed by Pieters with the invention as disclosed by Iwanczyk in order to ensure every detected photon is recorded, thus increasing the accuracy of the image produced from the data collected.

***Allowable Subject Matter***

11. Claims 17-19 and 30-31 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

The following is a statement of reasons for the indication of allowable subject matter:

Regarding claims 17-19 and 30-31, the allowable subject matter was disclosed in a prior office action dated December 13, 2005.

***Response to Arguments***

12. Applicant's arguments filed March 13, 2006 have been fully considered but they are not persuasive.

13. First, applicant argues that Iwanczyk teaches a method fabrication of a detector but does not detect actually detection photons. The examiner respectfully disagrees, in paragraph [0013], Iwanczyk discloses a radiography system where radiation (photons) are detected using an array detector. Therefore Iwanczyk affirmatively discloses a method of detection.

14. Second, applicant argues that Iwanczyk does not disclose detection of high energy photons. The examiner respectfully disagrees, Iwanczyk discloses detection of x-ray photons, which are inherently greater than 10KeV (see paragraph [0069]).

15. Third applicant argues that Iwanczyk does not specify measuring a single photon.

First, in response to applicant's arguments, the recitation "single photons" has not been given patentable weight because the recitation occurs in the preamble. A preamble is generally not accorded any patentable weight where it merely recites the purpose of a process or the intended use of a structure, and where the body of the claim does not depend on the preamble for completeness but, instead, the process steps or structural limitations are able to stand alone. See *In re Hirao*, 535 F.2d 67, 190 USPQ 15 (CCPA 1976) and *Kropa v. Robie*, 187 F.2d 150, 152, 88 USPQ 478, 481 (CCPA 1951).

Second, further, the definition cited by the applicant for a single photon (detection of 0-5 photons in a pixel per period of measurement) is not cited directly in the claim. Therefore "detecting single photons" is given the broadest reasonable interpretation, which the examiner has interpreted to mean measuring groups of single photons, as disclosed by Iwanczyk.

16. Applicant further argues that Iwanczyk fails to disclose detection of ionized particles within the polycrystalline film. The examiner respectfully disagrees. Direct detection of photons, by definition, is when radiation (in this case, high energy x-ray photons) interacts with the detector element (polycrystalline layer) and ionizes the detector element and the ionization event is readout using electrodes, which bias the ions to be collected. Figure 12, shows a direct conversion detector, that detects X-ray radiation, and inherently detects ionization events produced by such radiation within the polycrystalline film.

17. Lastly, applicant is reminded that the proper foreign priority documents have not been filed, thus applicant has not been afforded the priority date.

***Conclusion***

18. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Christine Sung whose telephone number is 571-272-2448. The examiner can normally be reached on Monday- Friday 7-3 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, David Porta can be reached on 571-272-2444. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Christine Sung
Examiner
Art Unit 2884

CS

OTILIA GABOR
PRIMARY EXAMINER